UNITED STATES ARMY AVIATION BOARD
Fort Rucker, Alabama

ATBG-DT-AVN-1661

15 FEB 1961

SUBJECT: Comparative Evaluation of Loudspeaker Systems for Transport Aircraft.

12 7p.

TO: Commanding General
United States Continental Army Command
ATTN: ATDEV
Fort Monroe, Virginia

This report describes the

1. AUTHORITY.

a. Directive. Letter, ATDEV-6 452(21 Nov 60), Headquarters, USCONARC, 21 November 1960, subject: "Evaluation of Loudspeaker Systems for HC-1B and AC-1 Aircraft."

b. Purpose. To conduct a comparative evaluation of available aircraft loudspeaker systems to determine the one most suitable for Army use in transport aircraft. The system is required to provide adequate communication between the troop commander/aircraft crew and the passengers while in flight.

2. BACKGROUND.

a. On 27 August 1957, the US Army Aviation School submitted a statement of requirement to Headquarters, USCONARC, for an aircraft-mounted loudspeaker system to provide a satisfactory means to transmit oral commands and briefings to troops aboard Army transport aircraft while the engines were running. A public address system is required by military characteristics for the 3-ton STOL aircraft and for the Chinook (paragraph 8e and f).

b. During the YHC-1B mock-up on 27-29 January 1960, the Aviation Board recommended the Bendix MI-51B in lieu of the AN/AIC-13 Loudspeaker System, which was programmed for installation. This

recommendation was made because all available information indicated that the AIC-13 was unsatisfactory. The Bendix system offered advantages in weight and simplicity and had a proven record in commercial applications but had not been tested by the Army. The OCSIGO representatives indicated a reluctance to use the Bendix system since it was not designed to Military Standards. This Board's recommendation was adopted by the mock-up board. As a result, USCONARC recommended the installation of the Bendix system in the AC-1 in lieu of the AIC-13.

c. The Aviation Board was directed to test the Bendix system. The test was later expanded (paragraph 1) to include a comparative evaluation of other available systems. Of these, the Aircraft Radio Corporation (ARC) Type F-17A and the Dayton Aircraft Radio Equipment (DARE) DAS-1B systems were tested.

d. The Bendix and ARC systems were received 10 October 1960 and the DARE system, 21 November 1960.

e. Subsequent to completion of testing, USCONARC recommended the deletion of the loudspeaker system from Military Characteristics, Type specifications, and Table E's for AC-1 and HC-1B aircraft (reference 8g).

3. DESCRIPTION OF MATERIEL.

a. Bendix MI-51B2.

(1) The Bendix MI-51 unit is a transistor-amplifier and a four-inch loudspeaker combination which is contained in a plastic case measuring 6.1 x 5.7 x 3.0 inches. The unit operates from the aircraft 27.5 volt d.c. power source. Maximum power output is four watts. The unit weighs two pounds and one ounce, may be mounted in any position, and requires no shock mounts.

(2) An installation of eight units was used in the first test and an installation of ten units was used in the second test. In both tests one of the units functioned as a driver.

b. ARC Type F-17A.

(1) The ARC Type F-17A Unit is a transistorized audio amplifier completely contained in an aluminum case 2.5 x 6.03 x 8.0 inches. The unit operates from the aircraft 27.5 volt d.c. power source. Maximum power output is 10 watts. The unit weighs 3.5 pounds and is supplied with shock mounts which permit it to be mounted in any position.

(2) University G-50-MRC trumpet-type five-inch loudspeakers weighing one pound were provided with the F-17A Audio Amplifier during the evaluation.

(3) Three ARC F-17A's, each driving two speakers, were used during the evaluation.

c. The DARE DAS-1B.

(1) The DARE DAS-1B unit is a transistor-amplifier and five-inch loudspeaker combination. The amplifier is built around the speaker "pot". The unit is not cased and measures 2.75 inches deep x 5.0 inches maximum diameter. The unit operates from the aircraft 27.5 volt d.c. power source (14-volt source can also be used). Maximum power output is 10 watts. The unit weighs one pound six ounces, may be mounted in any position, and requires no shock mounts.

(2) An installation consisting of seven units and one DSD-1 driver was used in the evaluation.

4. SUMMARY OF TESTS. Two spearate evaluations were made in a YAC-1 airplane. The initial evaluation was the ARC-17A with six speakers against the Bendix MI-51B with eight speakers. The final evaluation was the Bendix MI-51B with ten speakers against the DARE DAS-1 with seven speakers. The systems were wired to permit instantaneous switching of speech input from one system to the other, thus providing a quick "A-B" comparison.

a. Installation.

(1) In the evaluation of the Bendix and the ARC systems the speakers were mounted along the sides of the cargo-passenger

compartment approximately the entire length with a Bendix and an ARC system adjacent to each other, except in the after section of the airplane where two additional Bendix speakers were mounted.

(2) In the Bendix and DARE evaluation the speakers were mounted the approximate length of the cargo/passenger compartment along the centerline of the ceiling. The systems were adjacent to each other except in the extreme after section where two additional Bendix speakers were mounted.

(3) The Bendix and ARC were supplied in cases for surface mounting. Aluminum cases, similar to the Bendix, were fabricated locally for the DARE speakers. These cases were needed only in the test for ease of installation.

b. Operational Characteristics.

(1) Input to the loudspeaker systems was from the C1611/AIC-12 control units of the aircraft intercommunication set, AN/AIC-12( ). The INT position of the C-1611 selector switch was used for loudspeaker system operation. Voice input was accepted from pilot and copilot stations, and from the after AIC-12 station in the cargo/passenger compartment. The boom microphone M-33A/AIC (integral to Headset HS-101) was used at the cockpit stations. Acoustic feedback prevented use of the M-33A in the troop compartment. The hand microphone M-34/AIC with acoustic shield MX-1334/U operated satisfactorily from the troop compartment AIC Station. When using the hand microphone, it was necessary manually to disconnect the boom microphone of the headset at that station to prevent feed-back.

(2) The systems were tested under all normal regimes of flight with cargo doors opened and closed. During cruise and power-off conditions all transmissions over all systems were audible and readable, but those from the ARC and the Bendix were not as clear as those from the DARE. Under high engine power settings, the Bendix and ARC systems were barely audible and not readable; the DARE system transmissions were weak but audible and readable. In all transmissions the DARE system was considered by all participants in the test to be the most audible and readable.

(3) Outputs from one of the aircraft radios were fed through the loudspeaker systems, and this mode of operation was determined to be feasible.

c. Tactical Suitability.

(1) The Bendix system with eight speakers was considered more suitable than the ARC system with eight speakers, and the DARE system with seven speakers was considered superior to either of the other systems with 10 speakers.

(2) During the test period all systems were considered suitably rugged.

d. Personnel. The amount of training required to familiarize personnel with the operation of the systems was negligible. Radio repairmen with MOS number 298 could maintain the system satisfactorily. The manufacturer's operating instructions were adequate.

e. Maintenance. Installation was accomplished by USASATSA, and preventive maintenance only was required during the evaluations. Maintenance packages were not required and were not furnished.

f. Corrective Action Recommended for the DARE DAS-1B.

SHORTCOMINGS.	RECOMMENDED CORRECTIVE ACTION
(1) The speaker drive unit did not provide impedance match to the AN/AIC-12 system output.	Modify DSD-1 to match the 150-ohm output of AN/AIC-12.
(2) The units did not have a fuse in the d.c. input line.	Provide a fuse of appropriate capacity in each DAS-1B amplifier-speaker unit, and in the DSD-1 driver unit.
(3) The input connector was not of the Military Standard AN series.	Provide an appropriate connector of the Military Standard AN series.

5. DISCUSSION.

a. The equipment installations were not optimised with respect to speaker locations, orientation, and method of mounting. The nature of the evaluation and the limited time dictated hasty installations. Requirements for mounting the speakers are expected to vary with the type of aircraft, and conceivably may vary with location of individual speakers within an aircraft. Therefore, location and mounting provisions should be the responsibility of the airframe manufacturer.

b. The ultimate installation should accept input from any aircraft intercommunication control station and should be designed to preclude feedback. There should also be provisions for accepting input from the aircraft tactical radio receiver.

6. CONCLUSION. The DARE DAS-1B Loudspeaker System was more suitable than either the Bendix MI-51B2 or the ARC F-17A Loudspeaker Systems for Army use in transport aircraft.

7. RECOMMENDATIONS. It is recommended that:

a. No further consideration be given either the Bendix Type MI-51B System or ARC Type F-17A System for use in Army transport aircraft.

b. If and when the requirement for a loudspeaker system for use in Army transport aircraft is re-established:

(1) The DARE DAS-1B Loudspeaker System be modified to correct the shortcomings noted in paragraph 4f above and be type classified Standard A for use in Army transport aircraft.

(2) Further engineering studies be conducted to determine the optimum number and location of speaker units where required in Army transport aircraft.

8. REFERENCES.

a. Letter, ATDEV-6 413.4/66, 6 March 1959, Headquarters, USCONARC, 24 June 1959, subject: "Termination of Service Test of AN/AIC-13."

b. Letter, ATDEV-6 413.4, Headquarters, USCONARC, 5 February 1960, subject: "Loudspeaker System for HC-1B and AC-1."

c. Letter, ATDEV-6 413.4, Headquarters, USCONARC, 21 March 1960, subject: "Loudspeaker System for HC-1B and AC-1," with three indorsements.

d. Line Item F192, Materiel Development Program, Fiscal Year 1961, Headquarters, USCONARC, 1 July 1960.

e. Military Characteristics for Airplane, Transport, 3-Ton (STOL) (U), TCTC Item 2906 (TCTC Meeting 121, 6 March 1959).

f. Military Characteristics for Helicopter, Transport, Medium, New (U), TC Technical Committee Item 2167.

g. Message, ATDEV-6 799670, CG, USCONARC, 31 January 1961.

9. COORDINATION. This report has been coordinated with the US Army Aviation School.

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